THE WEATHER AND CIRCULATION OF SEPTEMBER 1950[1]

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The upper level wave pattern of the main westerly belt in the North American region was relatively simple during September 1950, with deep troughs in the eastern Pacific and eastern Canada and a broad ridge over western Canada (fig. 1 and Charts IX to XI). In the Canadian Arctic there existed essentially one deep polar vortex with a trough extending southeastward from it into the eastern Canadian trough. Over the United States and adjacent oceans, which were south of the principal westerly stream, the circulation was more complex with troughs at 700 mb. (fig. 1) over the Great Basin, the Gulf of Mexico, and the western Atlantic and ridges over the Pacific Coast, the Great Plains, and the Bahamas. The 700-mb. height anomaly configuration in figure 1 shows an extensive area of above normal heights in Canada with a +200-ft. center in Manitoba. This area was almost completely surrounded by negative height anomalies extending from the Gulf of Alaska clockwise through the Canadian Arctic, eastern North America, and the Gulf of Mexico into the southwestern United States and Mexico. Only along the west coast of the United States did positive height anomalies extend to lower latitudes from the Canadian area. Thus the mean 700-mb.

[1] See Charts I–XI following p. 184, for analyzed climatological data for the month.

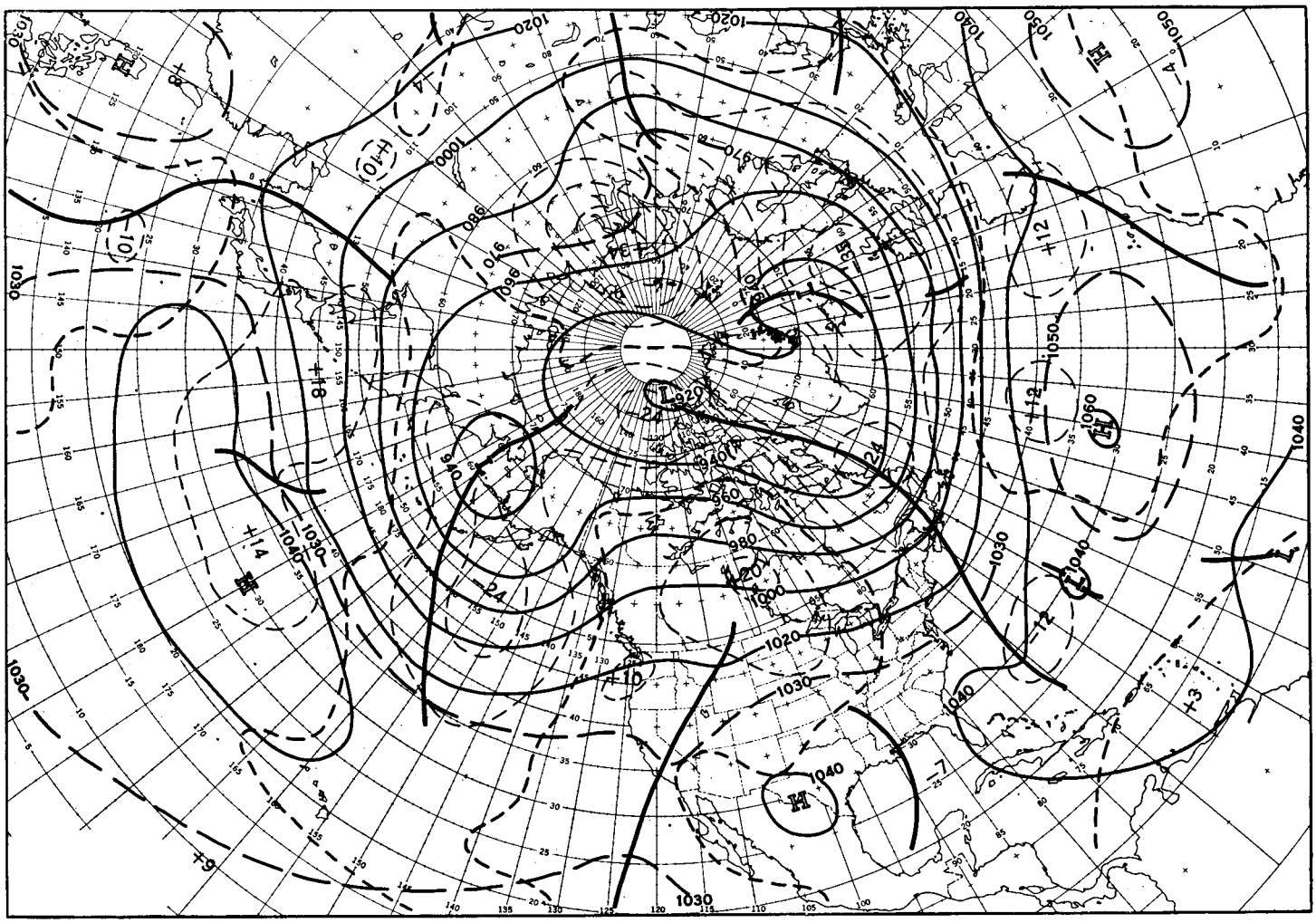

FIGURE 1.—Mean 700-mb. chart for the 30-day period August 28–September 27, 1950. Contours at 200-foot intervals are shown by solid lines, 700-mb. height departures from normal at 100-foot intervals by dashed lines with the zero isopleth heavier. Anomaly centers and contours are labeled in tens of feet. Minimum latitude trough locations are shown by heavy solid lines.

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gradient flow considered with respect to normal was southerly in the Gulf of Alaska and western Canada, westerly in northern Canada, northerly in eastern Canada, and easterly over practically all of the United States.

The strong northerly flow relative to normal at 700 mb. in eastern Canada led to repeated invasions of cold continental polar air into the northeastern United States, so that below normal temperatures were general in most of that area (Chart I). These cold air outbreaks were associated with anticyclonic conditions at sea level in southern Canada and the northern United States as indicated by the anticyclone paths (Chart II), and by the mean high pressure and positive pressure anomaly in the northern United States (Charts VI and II inset). Temperatures were especially low in northern New England where it was the coolest September on record at some stations in Maine. Over the central and southern United States stronger-than-normal easterly flow at sea level (Charts VI and II inset) and northeasterly flow relative to normal aloft (fig. 1) allowed the cold polar air associated with the Canadian Highs to penetrate into the Mississippi Valley, the central Plains States, and even to the eastern slopes of the Rockies. This polar air was not warmed very much as it passed through the central Mississippi Valley and the Ozarks due to the trough conditions aloft and the associated cloudiness (note center of low percentage of clear sky in that area shown in Chart IV). In fact some of the greatest negative temperature anomalies in the whole country were located in western Kansas and along the Texas-Oklahoma boundary.

Cool weather in the East was accentuated somewhat by the persistent high level smoke layers which blanketed much of the eastern third of the country in the last week of September. (See article by Smith in this issue of Monthly Weather Review.) This smoke originated in extensive forest fires in western Canada and was carried into the eastern United States by northwesterly flow aloft. (The smoke traveled with the upper circulation and was reported a few days later over Great Britain and western Europe and in early October over the Aleutians.) The smoke layers had a marked cooling effect on the surface temperatures since they restricted the incoming short wave solar radiation, but had little effect on the outgoing long wave terrestrial radiation.

Above normal temperatures were observed in North Dakota, Minnesota, and the Pacific Northwest where there were ridge conditions and above normal heights at 700 mb. (fig. 1). Temperatures were also above normal in Nevada and California despite the presence of a weak trough in the area, because 700-mb. heights were above normal and there was a well pronounced thermal low at sea level (Chart VI). The warm weather in south Texas occurred almost directly under the high center aloft even though heights were slightly below normal in this anticyclone.

Since the fastest westerlies in North America were located over the northern half of Canada during the month, most cyclone centers traveled eastward across Canada well to the north of the United States border generally along the mean 700-mb. flow (compare Chart III and fig. 1). Thus the observed precipitation pattern over the United States (Chart V and inset) was characteristic of the summer type where the distribution of precipitation is largely determined by the mean position of moist and dry tongues. This can best be demonstrated by a monthly mean isentropic chart.[2] In the absence of such a chart, however, the mean flow patterns at 700 mb. and sea level and their departures from normal can help to explain much of the September precipitation distribution.

Precipitation amounts were less than normal from the upper Great Lakes southwestward into Kansas and Oklahoma (Chart V inset). This entire region of light precipitation was located just east of the Plains ridge at 700 mb. (fig. 1) and close to the mean high center over the upper Great Lakes at sea level (Chart VI). In addition the flow relative to normal was northeasterly both at sea level and aloft (Chart II inset and fig. 1). The light precipitation in New England occurred under stronger-than-normal northwesterly flow aloft to the west of the Western Atlantic trough. Drier than normal weather also occurred in Oregon, Washington, and northern Idaho under the above normal Pacific Coast ridge at 700 mb.

The trough extending from the Gulf of Mexico northward into the Mississippi Valley was associated with greater than normal rainfall amounts in many areas from Florida northward into the Ohio Valley and eastward into the middle Atlantic States. Much of this precipitation occurred early in the month in connection with the intense hurricane which moved over Cuba and into the United States (Chart III) in the southerly flow to the east of the 700-mb. trough in figure 1. Both Jacksonville and Savannah recorded total rainfall for the month of about 17 inches.

The belt of heavy rainfall extending westward from Arkansas and Louisiana through Texas and northwestward through New Mexico and Colorado is difficult to explain from the anticyclonic northwesterly circulation on the mean 700-mb. chart in that region. Much of this rain also occurred in the early part of the month when the Gulf of Mexico—Mississippi Valley trough was an intense easterly wave, and the circulation over the South carried a large supply of moisture westward toward the Rockies. This circulation was reflected in the strong monthly mean sea level easterly and southeasterly flow (Charts VI and II inset) and in the easterly circulation with respect to normal at 700 mb. (fig. 1).

[2] H. Wexler and J. Namias, "Monthly isentropic charts and their relation to departures of summer rainfall," *Transactions of the American Geophysical Union*, vol. 19, 1938, pp. 164–170.

The large area of abnormally heavy precipitation extending from California northeastward to Montana and North Dakota was located in and to the east of the weak 700-mb. trough in the West. The combined effects of upslope easterly flow at the surface (Chart VI) and the overrunning southwesterly flow aloft were important in producing the portion of this excessive precipitation which occurred east of the Continental Divide. Considerable snow fell in Montana and Wyoming on the last 2 days of the month in connection with a deep storm which moved through Nevada and Utah (Chart III).

In closing it is interesting to note that the basic temperature pattern over the United States during September 1950, remained substantially the same as during the two preceding months (see Chart I of July and August 1950, Monthly Weather Reviews). Much of the eastern two-thirds of the country was cooler than normal, although in central sections there was some moderation of the extreme negative temperature anomalies of the two previous months. Precipitation was still copious in many sections of the country in September, but the heavy rains in Kansas and Oklahoma in July and August did not continue into September.

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, September 1950

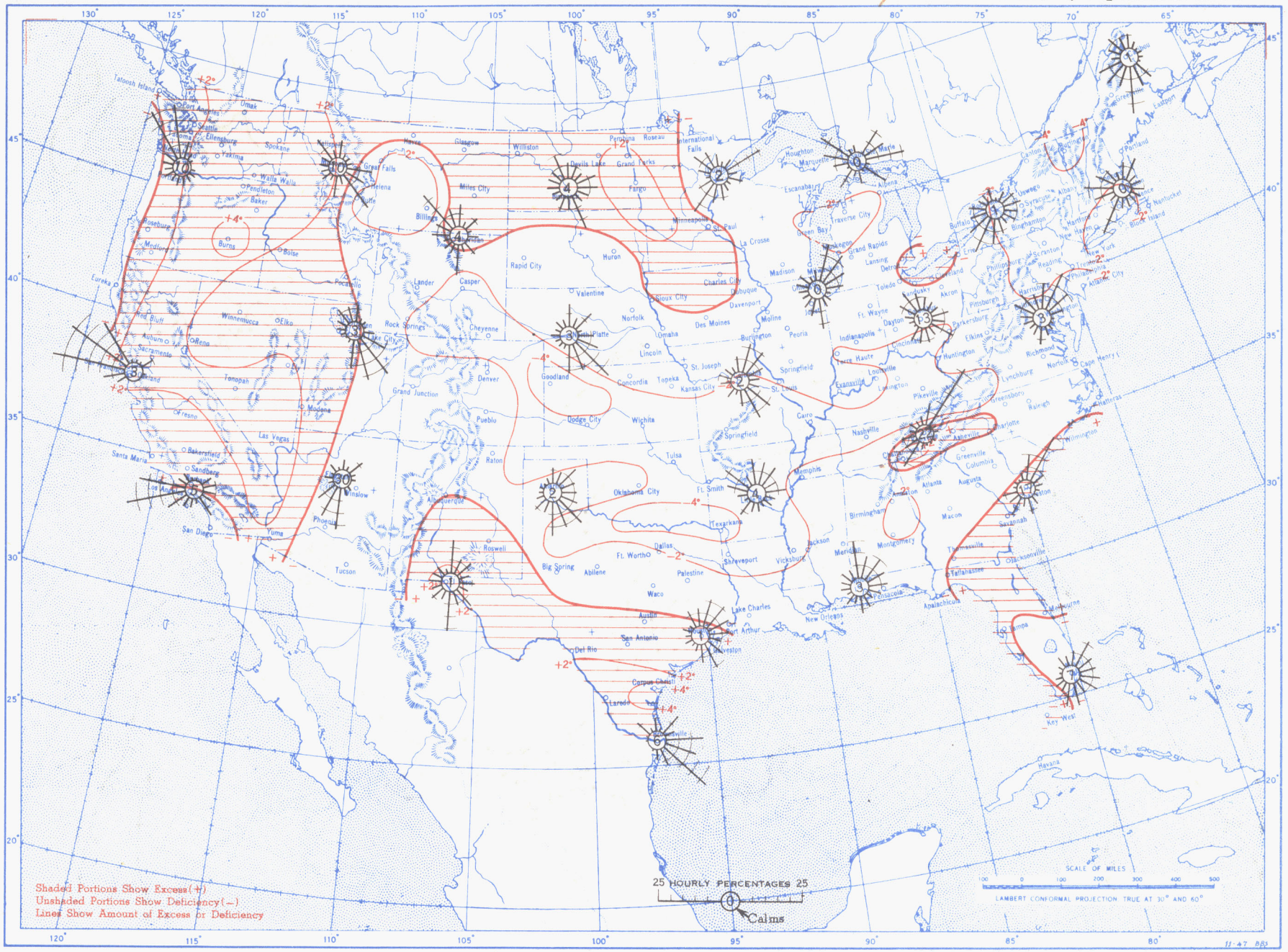
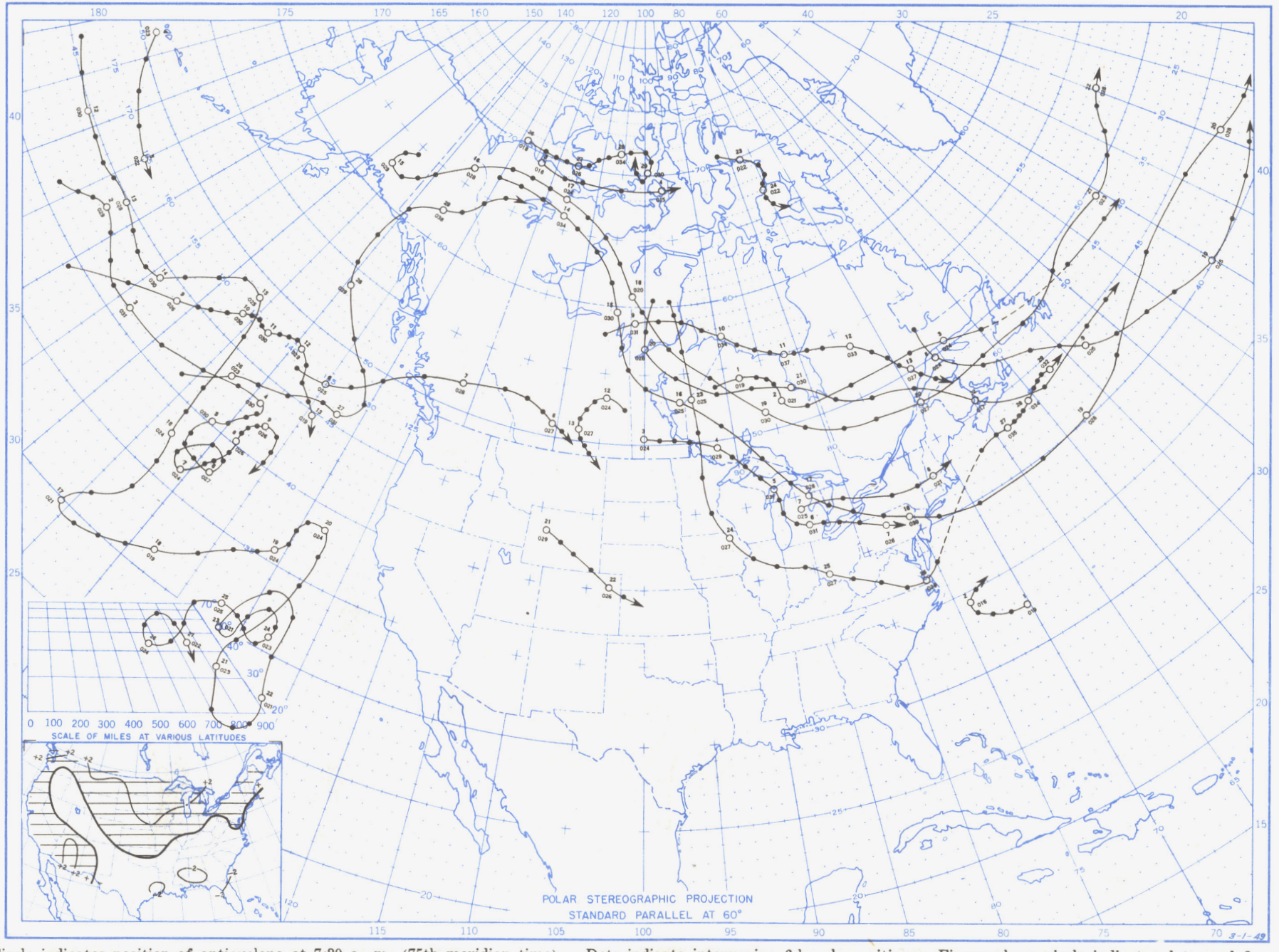
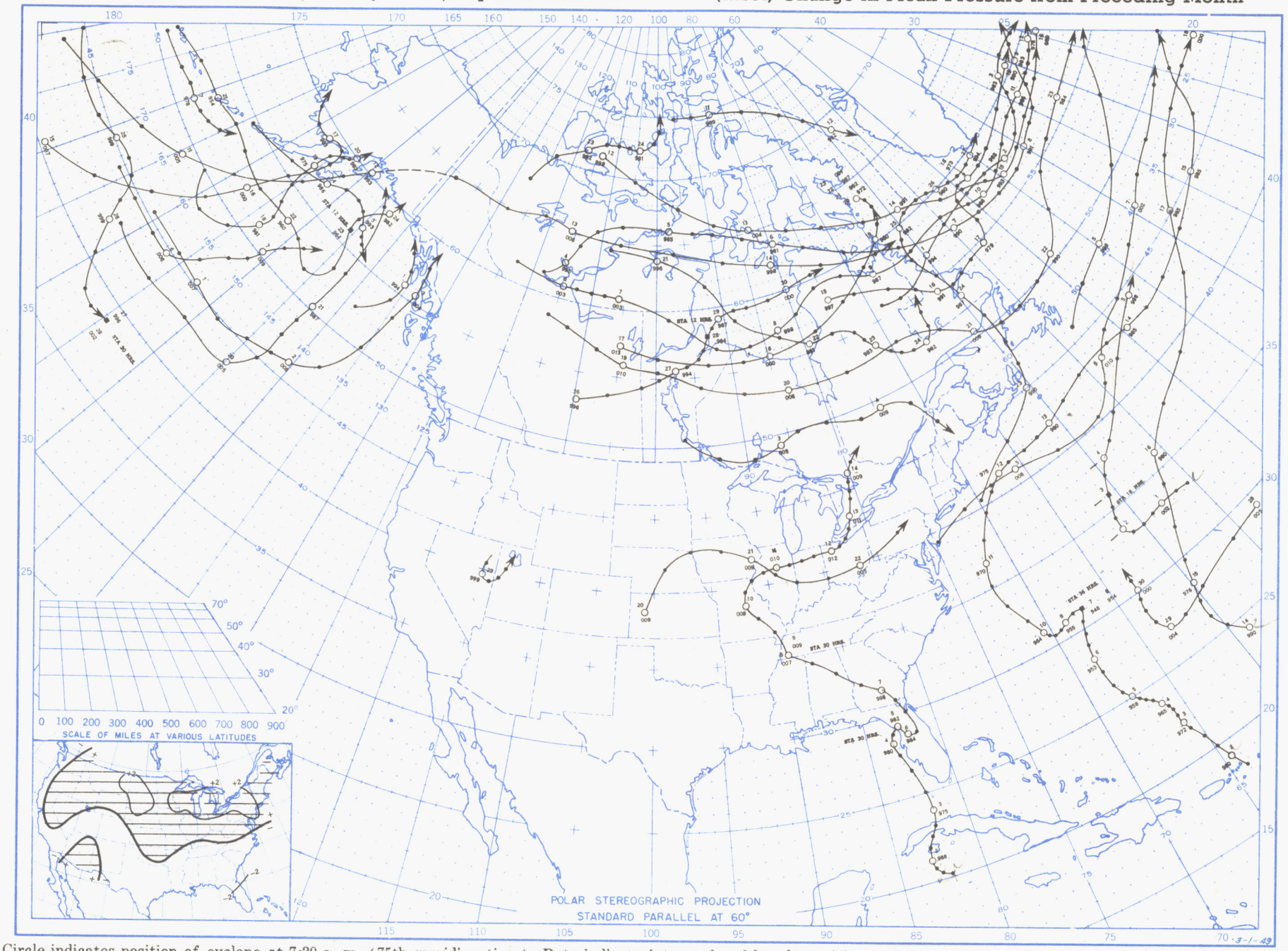


Chart II. Tracks of Centers of Anticyclones, September 1950. (Inset) Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart III. Tracks of Centers of Cyclones, September 1950. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time) Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, September 1950

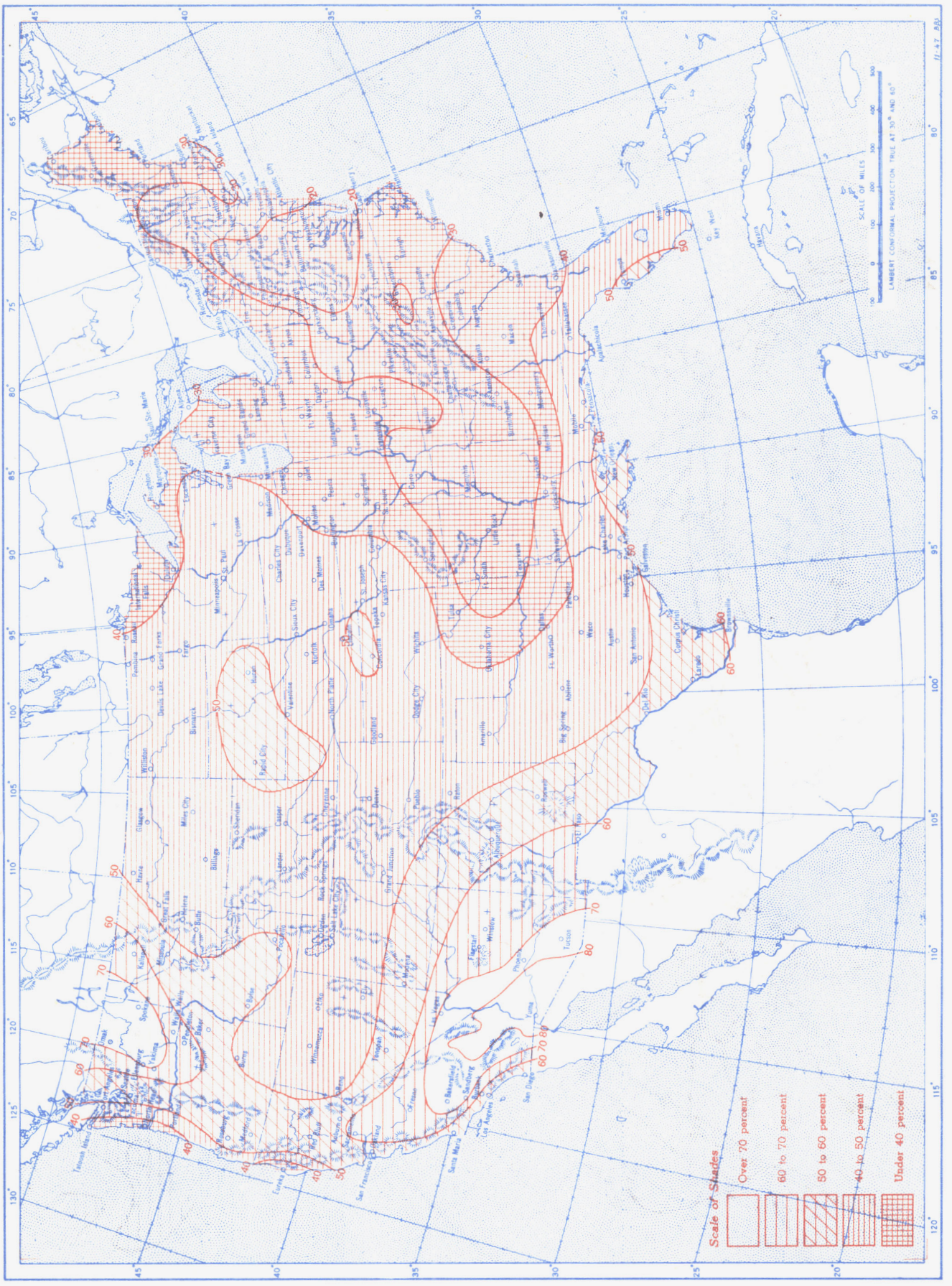


Chart V. Total Precipitation, Inches, September 1950. (Inset) Departure of Precipitation from Normal

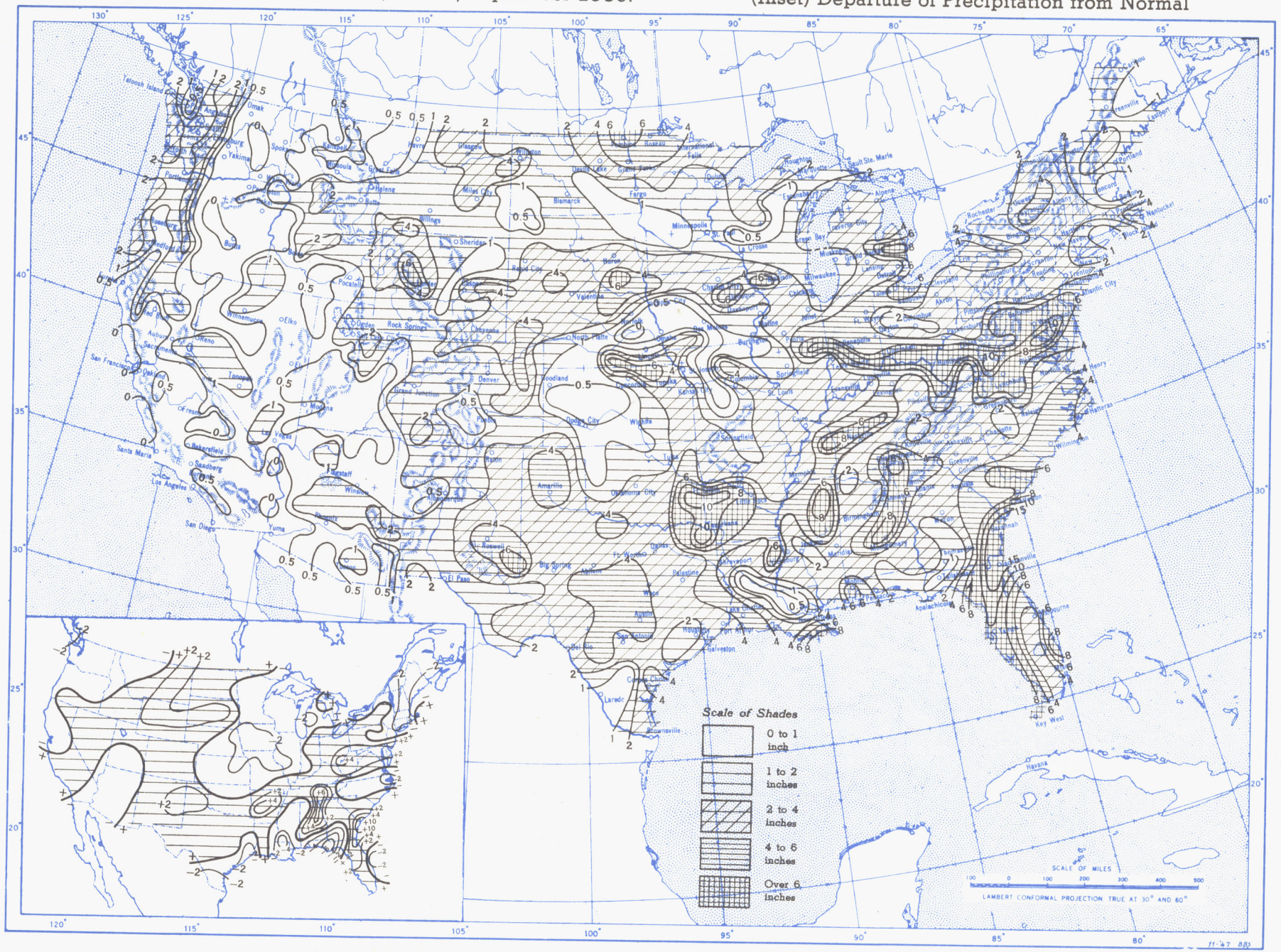


Chart VI. Mean Isobars (mb.) at Sea Level and Mean Isotherms (°F.) at Surface., September 1950

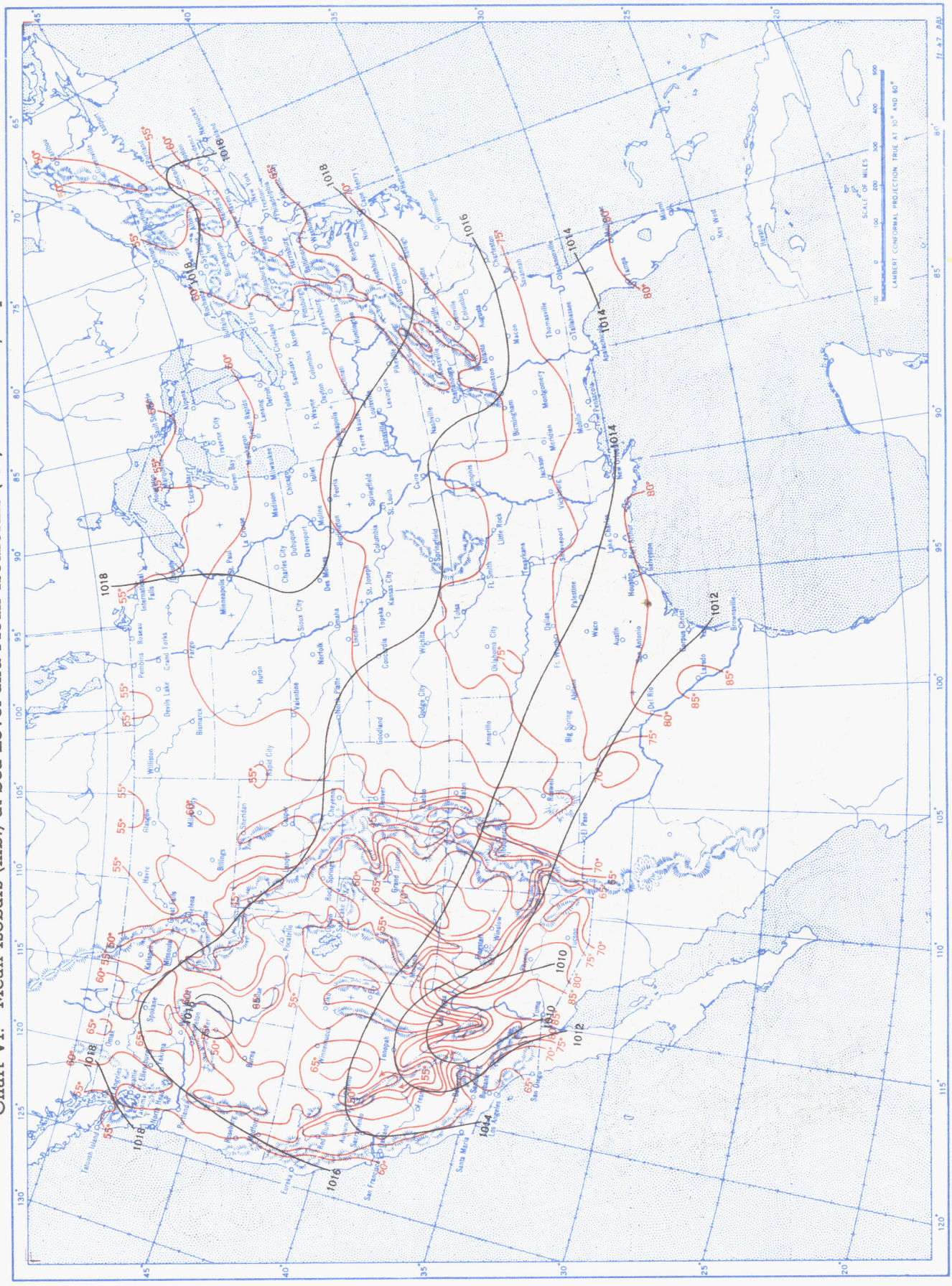
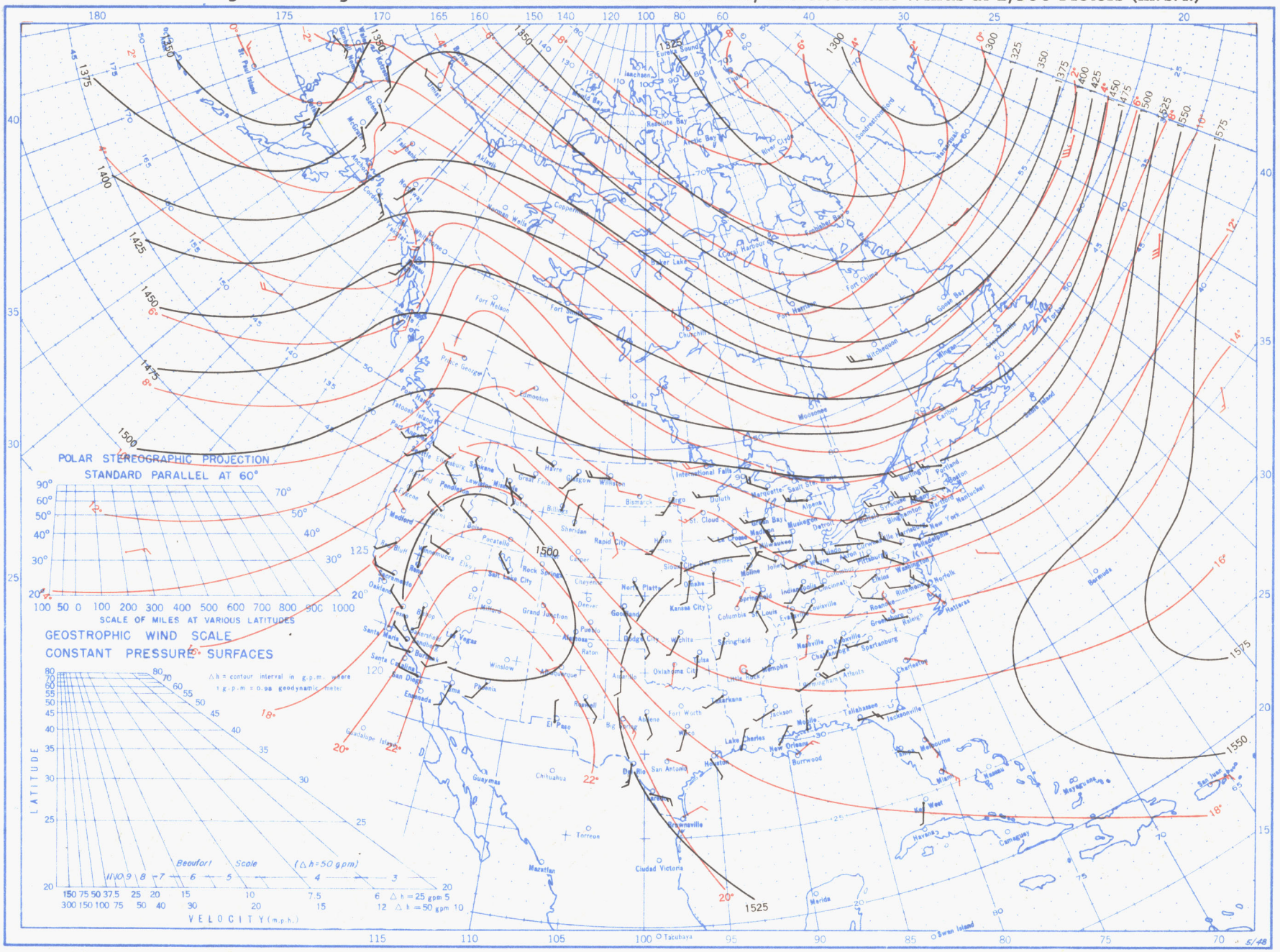
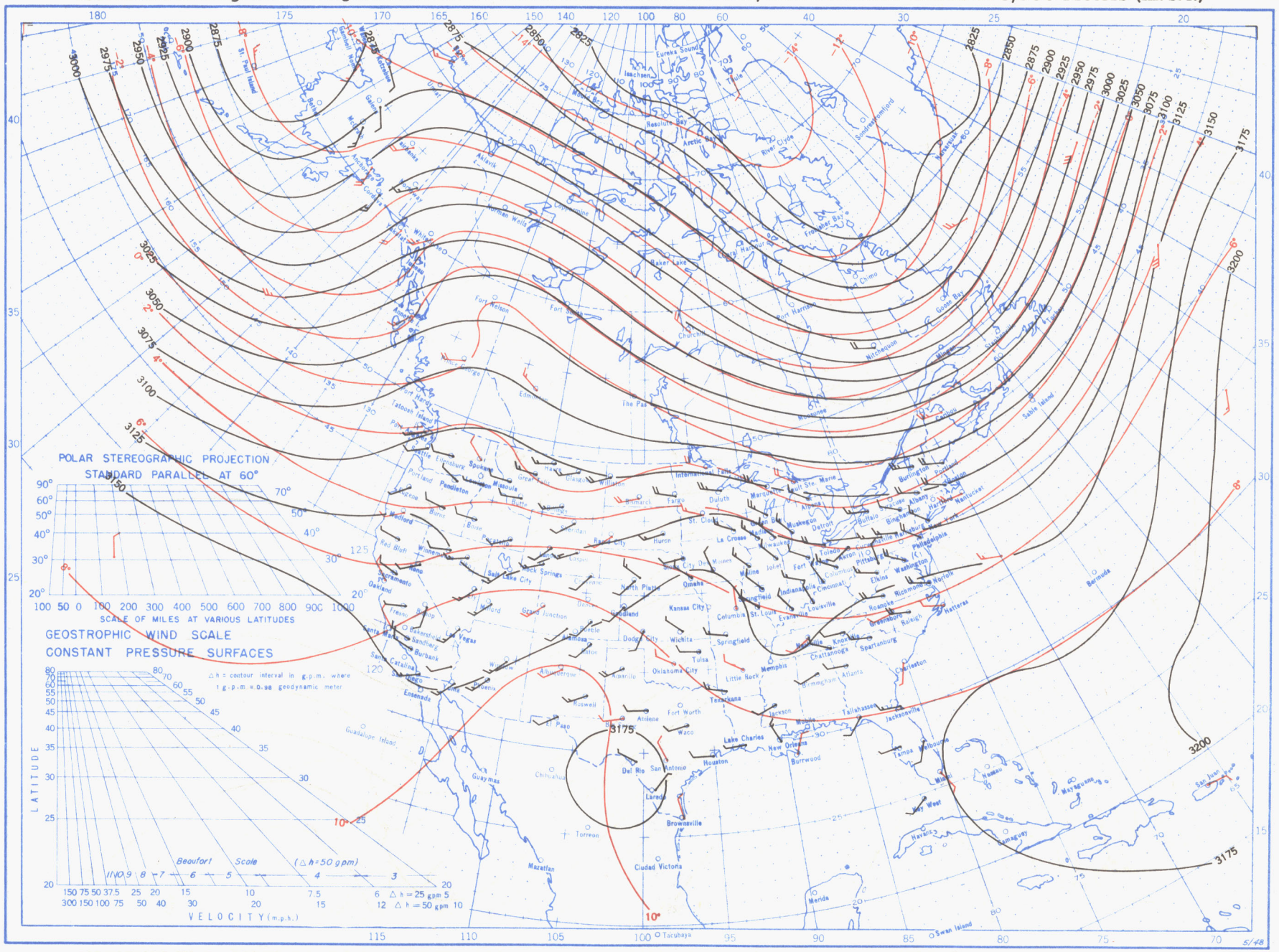


Chart VIII, September 1950. Contour Lines of Mean Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Mean Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m. s. l.)



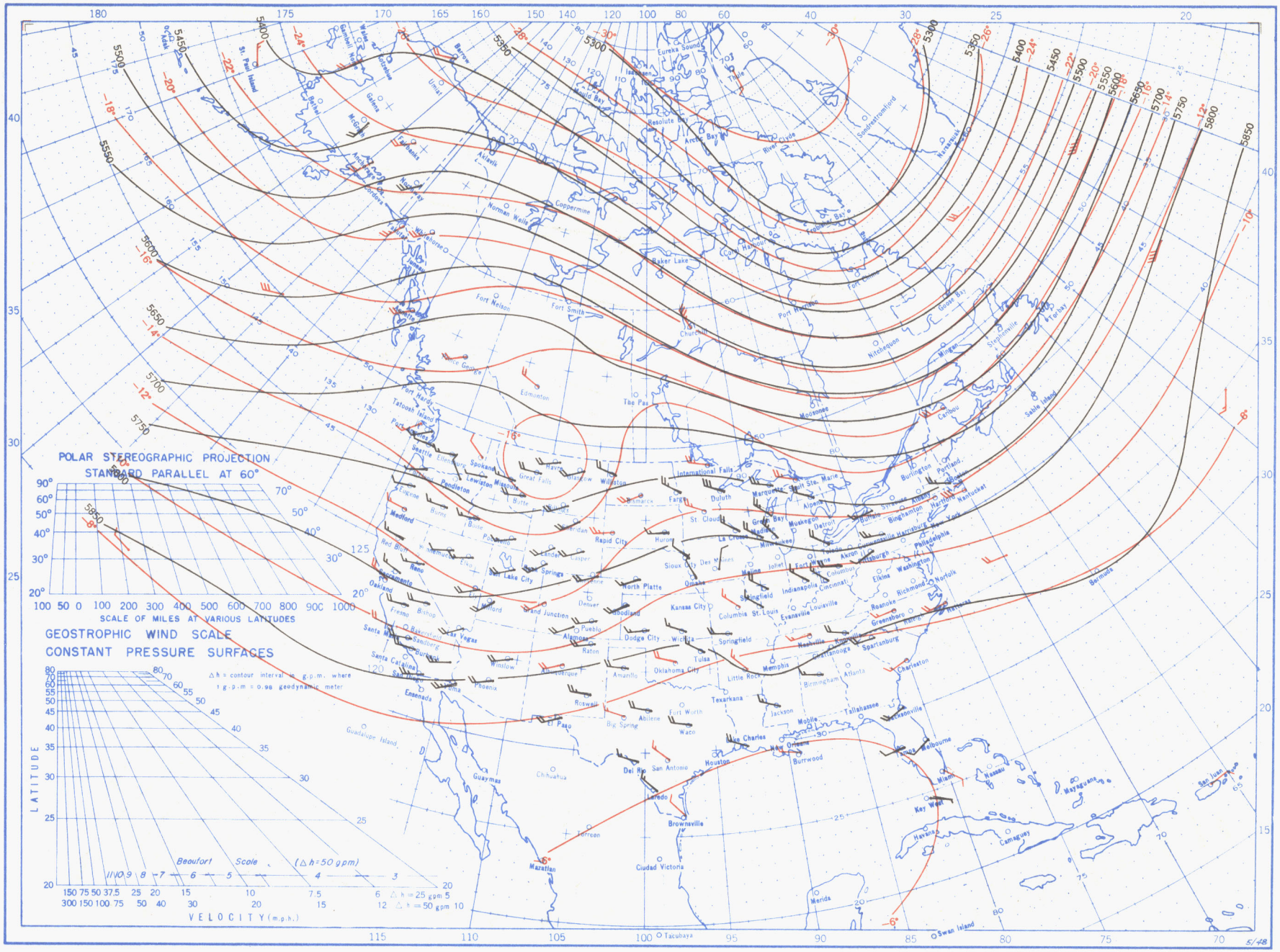
Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2100 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart IX, September 1950. Contour Lines of Mean Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Mean Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m. s. l.)



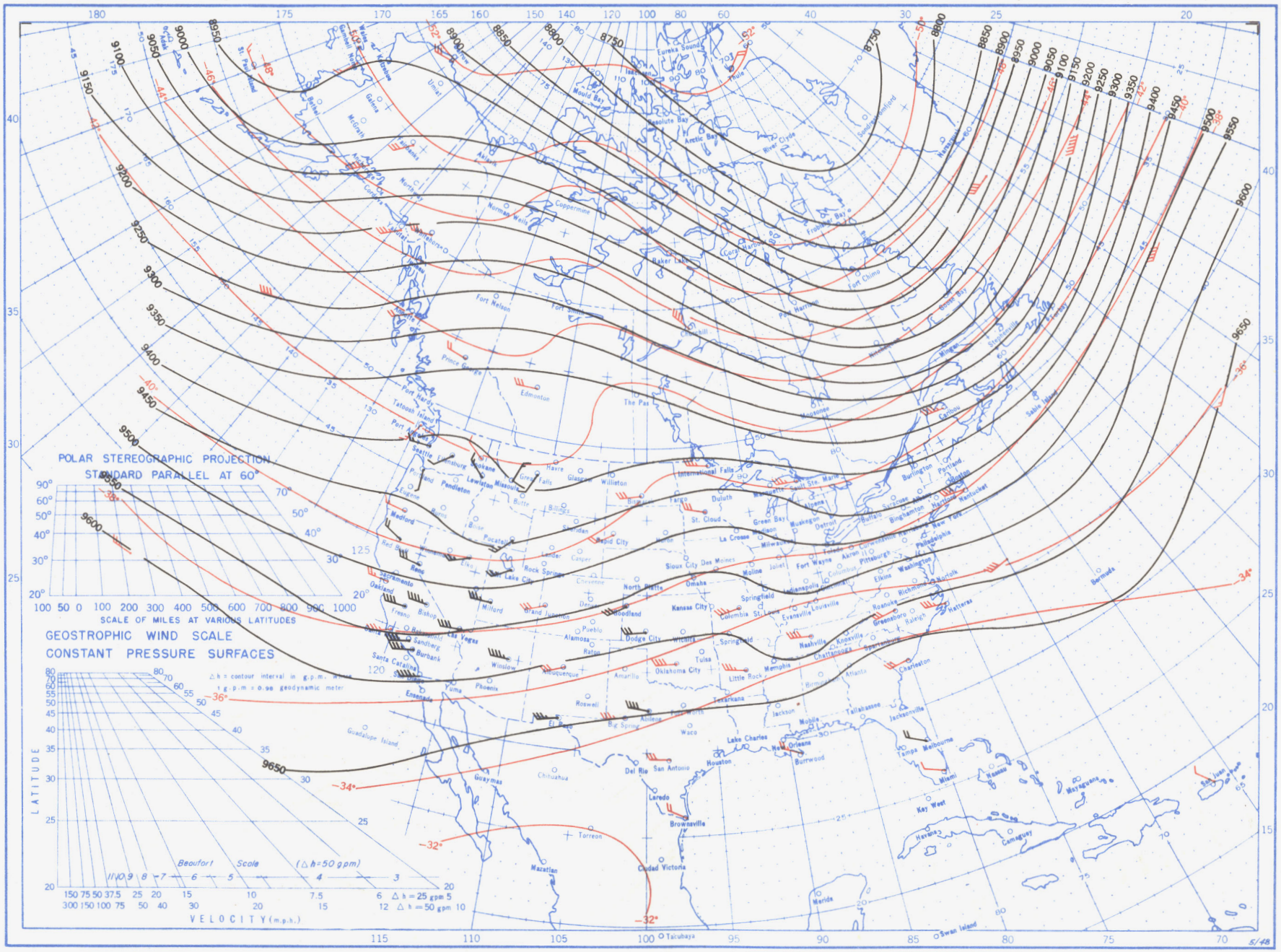
Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2100 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart X, September 1950. Contour Lines of Mean Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Mean Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2100 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart XI, September 1950. Contour Lines of Mean Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Mean Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2100 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.